

An Investigation of the Frequency of Consanguineous Marriages Among the Mormons and Their Relatives in the United States¹

C. M. WOOLF, F. E. STEPHENS, D. D. MULAİK, AND R. E. GILBERT

Laboratory of Human Genetics, University of Utah, Salt Lake City 12, Utah

INFORMATION ON THE FREQUENCY of consanguineous marriages in human populations is of interest to geneticists for several reasons. Much has been written on the potential value of this information for estimating the mutation rates (Neel, 1952) and frequencies (Lenz, 1919; Weinberg, 1920; Dahlberg, 1938; Hogben, 1946; Neel, Kodani, Brewer, and Anderson, 1949) of recessive genes as well as the size of the isolates into which populations are subdivided (Dahlberg, 1929, 1938; Morton, 1955). The assumptions involved in arriving at these determinations have been discussed by these authors as well as others. Information on the breeding structure of a population helps to estimate the rate with which induced mutations will manifest themselves in the homozygous condition. The theoretical aspects have been discussed by Haldane (1947) and they have been applied to a practical situation by Neel *et al* (1949) in their studies of the survivors of the atomic bombings of Hiroshima and Nagasaki. If the genetic equilibrium of a population were disturbed by an influx of sub-lethal recessive mutations, the number of generations required for equilibrium to be restored would be negatively correlated with the mean coefficient of inbreeding of the population. Therefore, other factors being equal, the genetic effects of an atomic bombing will be distributed over fewer generations and will likely be more obvious in those populations with a high frequency of consanguineous marriages.

The frequency of consanguineous marriages had been studied extensively in several different countries (see table 5). However, there are few references in the literature to studies carried out in the United States. In 1908, Arner estimated the frequency of first cousin marriages for the state of New York previous to 1784, and for Ashtabula County, Ohio, for the years 1811–1886, by using as an index the frequency with which similar surnames appeared on marriage licenses. For the New York population his estimate of the frequency of first cousin marriages was 2.7 per cent, while for the Ohio population it was 1.12 per cent. It was Arner's opinion that the frequency of first cousin marriages in the United States in 1908 varied greatly among different communities, ranging from about 0.5 per cent in the northern and western states to about 5.0 per cent in isolated mountain and island communities, with an overall frequency no greater than 1.0 per cent. He concluded that the frequency of consanguineous marriages was decreasing with increasing ease of transportation and communication,

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and that the frequency in 1908 was only half as great as in the days of the stage coach.

In recent times three studies have been carried out on white populations in the United States. Glass (1954; also see discussion of paper by Buzzatti-Traverso, 1950) initiated a study at the Rh Blood Typing Laboratory in Baltimore, Maryland, and found that 0.05 per cent of 8000 obstetrical patients were married to their first cousins. A similar figure was obtained by Steinberg (personal communication; also see discussion of paper by Buzzatti-Traverso, 1950) who obtained information about consanguineous marriages from 1,969 mothers during their lying-in period in a hospital in Rochester, Minnesota. Only one, or about 0.05 per cent, of these mothers was married to her first cousin. A preliminary report of a study still in progress was given by Herndon and Kerley at the 1952 meetings of the American Society of Human Genetics in Ithaca, New York. Through the courtesy of the investigators, some of their preliminary results are reviewed here. A reference to their study can also be found in Herndon (1954). The population under investigation is Watauga County, North Carolina. This county, located in the Blue Ridge Mountains, is rural and predominantly agricultural with no heavy industry. Twelve index couples were selected at random. Genealogical information was obtained on the relatives of both members of each index couple. The pedigrees thus obtained contained 1,651 marriages which occurred in the county during the period 1830 to 1950. These marriages were classified as to the degree of relationship existing between the marriage partners. The frequency of first cousin marriages declined over the years (see table 5). For the period 1830-1849, 4.08 per cent of 98 marriages were between first cousins, while for the period 1910-1929, only 0.91 per cent of 439 marriages were between first cousins. No first cousin marriages occurred during the period 1930-1950, in a total of 226 marriages. The frequency of cousin marriages, to and including fourth cousins, has also tended to decrease in recent years. The high point was for the period 1870-1889, when a frequency of 16.72 per cent, based on 299 marriages, was observed. For the period 1930-1950, the frequency was 10.18 per cent. Herndon and Kerley state that the high frequency for the period 1870-1889 is consistent with what could be expected from the history of the area. The frequency of consanguineous marriages increased following the Civil War when travel facilities and economic conditions were at a low ebb.

The present investigation was initiated because of the scarcity of data on the frequency of consanguineous marriages for the different areas in the United States. It is divided into three parts: (1) a study of the frequency of consanguineous marriages occurring in Utah for different periods of time from 1847, when the area was first settled, to 1950; (2) a study of the frequency of consanguineous marriages among the present residents of nine rural communities in Utah and Nevada that were colonized by Mormon pioneers during the latter part of the past century; (3) a study of the frequency of first cousin marriages among Mormons and their relatives in ten geographical regions in the United States for various periods of time from 1620 to 1950. The first and third studies were carried out by an analysis of genealogical records on file in the archives of the Genealogical Society of the Church of Jesus Christ of Latter Day Saints (Mormon) in Salt Lake City, Utah.

The Mormon Church encourages its members to take an active interest in genealogical research. The archives and library of the Genealogical Society are the center of this activity. Two types of records on file in the archives can be used as source material to obtain information on the frequency of consanguineous marriages: pedigrees and family group records. These records are placed in the archives by the members of the church and by professional genealogists employed by the Genealogical Society. A single pedigree sheet contains the name of a *propositus* and information about his maternal and paternal ancestors for four generations. The *propositus* may be the person who submitted the sheet or a relative or ancestor of that person. When a genealogical line is known for more than five generations, the line is continued on a new pedigree sheet with the individual in the fifth ancestral generation becoming the *propositus* of the new pedigree sheet. These sheets are filed alphabetically by the surname of the *propositus*, who may be either a male or a female. A family group record, in addition to other information, contains the names of a husband and wife, the names of their children and parents, and the date and place of their marriage. At the present time, approximately three million family group records are on file in the archives, and the number is increasing rapidly. The family group records contain information on families from many parts of the world and cover many generations.

The pedigree records are more applicable to investigations of this type than the family group records, because the latter are accurate only for relationships up to and including full first cousins. However, the pedigree records are limited in number.

PROCEDURE AND RESULTS

1) *The Frequency of Consanguineous Marriages in Utah During Various Periods of Time, From 1847 to 1950.*

This study was initiated by using the pedigree records. A sample of these was taken; for those marriages occurring in Utah, a notation was made of the year of the marriage and the degree of relationship existing between the marriage partners. The degree of relationship was expressed as the coefficient of relationship (Wright, 1922; Li, 1955). In most cases the relationship was easily determined from the information occurring on a single pedigree sheet. In other cases it was necessary to search other records and sources of information.

Since the derived estimates of the frequencies of the various types of consanguineous marriages cannot be any more reliable than the records themselves, the estimates are probably too low. The underestimation is probably not as great for close relationships, such as uncle-niece and first cousins, as it is for more distant relationships. The error should not be as great for the marriages occurring in recent times as for those occurring several generations ago. Underestimation of the true values is typical of the other large-scale studies reported in the literature.

The results of the analysis of the pedigree records are shown in table 1. Thirty six thousand nine hundred nine marriages were classified. The table shows the frequency of uncle-niece, first cousin, first cousin once removed, and second cousin marriages for the various periods of time. Marriages having the same coefficient of relationship were grouped under a common heading. Other types of relationship, such as third cousin, etc., are grouped under "Other Consanguinity". No aunt-nephew marriages

were observed. Wright's (1922) mean coefficient of inbreeding (α) was determined for the various periods of time following the procedure of Haldane and Moshinsky (1939).

It is apparent from the table that the pedigree records yielded little data for marriages occurring in recent years. In order to increase the data for the present generation, the family group records were utilized. The procedure was to sample the records for those marriages occurring in Utah since 1910, and to compare the surnames of the parents of the husband and wife. The year 1910 was arbitrarily chosen. If the surname of one of the parents of the husband was the same as one of the wife's parents, the marriage was classified as a potential first cousin marriage. These were investigated further with the aid of all available records on file in the various offices of the genealogical society. Since only recent marriages occurring in Utah were classified, and it was only a question of whether the husband and wife were first cousins, supporting records were obtained in most cases. But, again, due to inadequacy of the records in some cases, the estimates are apt to be too low.

The results of the survey of the family group records are shown in table 2. A total of 41,631 marriages were classified. The trend in the frequency of first cousin marriages in Utah over the past century may be seen best by comparing the data for the intervals between 1847 and 1909 in table 1 with the data in table 2.

TABLE 1. THE FREQUENCY OF THE VARIOUS TYPES OF CONSANGUINEOUS MARRIAGES IN UTAH FROM 1847 TO 1950. INFORMATION OBTAINED FROM THE ANALYSIS OF PEDIGREE RECORDS ON FILE IN THE ARCHIVES OF THE L.D.S. GENEALOGICAL SOCIETY

Period	Total Marriages	Uncle-Niece	First Cousin	First Cousin Once Removed	Second Cousin	Other Consanguinity	Total Consanguinity	α
1847-1869	13,955	22 (0.16%)	76 (0.54%)	10 (0.07%)	14 (0.10%)	2 (0.01%)	124 (0.89%)	0.00058
1870-1889	13,361	8 (0.06%)	130 (0.97%)	37 (0.28%)	27 (0.20%)	15 (0.11%)	217 (1.62%)	0.00088
1890-1909	7,197	0	19 (0.26%)	20 (0.28%)	14 (0.19%)	8 (0.11%)	61 (0.85%)	0.00032
1910-1929	2,217	0	2 (0.09%)	6 (0.27%)	7 (0.32%)	9 (0.41%)	24 (1.08%)	0.00026
1930-1950	179	0	0	0	0	0	0	—

TABLE 2. THE FREQUENCY OF FIRST COUSIN MARRIAGES IN UTAH FROM 1910 TO 1950. INFORMATION OBTAINED FROM THE ANALYSIS OF FAMILY GROUP RECORDS ON FILE IN THE ARCHIVES OF THE L.D.S. GENEALOGICAL OFFICE

Period	Total Marriages	First Cousins
1910-1929	26,325	19 (0.07%)
1930-1950	15,306	6 (0.04%)

2) *Survey of Selected Rural Communities in Utah and Nevada.*

From the analysis of the pedigree and family group records it became obvious, especially for relatively recent times, that consanguineous marriages were occurring most frequently among the residents of rural communities. This is to be expected. Unless a distinct social attitude exists toward the occurrence of consanguineous marriages, populations that constitute small isolates due to geographic or social isolation, or to restricted mobility, will tend to show an increased frequency of cousin marriages (Stern, 1950). This consideration, along with the average number of marrying children per family, forms the basis of Dahlberg's method (1929, 1938) for determining the size of the isolates into which populations are subdivided.

None of the first cousin marriages shown in table 2 for the period 1930-1950, occurred among individuals living in urban areas; hence the rural areas are contributing disproportionately to the total frequency for the state.

Nine small rural communities in the intermountain area were selected for study to obtain information on the segment of the population in Utah with the highest frequency of consanguineous marriages. They were selected because they were known to have a high frequency of consanguineous marriages or because their location and history suggested they might have a high frequency of consanguineous marriages.

Door to door surveys were conducted to determine the frequency of consanguineous marriages among the present residents. Some of the communities were completely surveyed, while only a random sample of marriages was taken in others. Genealogical records in the possession of some of the residents, records on file in the local churches, as well as interested persons who had spent their lives in the communities were used in the compilation of the pedigree charts.

The communities studied and the results obtained are shown in table 3. Six hundred twenty-five marriages were classified. The mean coefficient of inbreeding was calculated for each community as well as for all the communities taken as a group. The closest degree of relationship encountered between the marriage partners was first cousin.

3) *The Frequency of First Cousin Marriages in Ten Geographical Regions in the United States During Various Periods of Time from 1620 to 1950.*

The Mormon Church which was organized in 1830, in Fayette, Seneca County, New York, now has a million and a half members. Between 1831 and 1847 the members of the growing church settled in communities in Ohio, Missouri, and Illinois. In 1847 the church moved westward to the valley of the Great Salt Lake. From its beginning, the Mormon Church has been a proselyting church. Missionaries are sent at their own expense to all parts of the United States and into many different countries, with the consequence that converts are greatly diversified in regard to geographic origin. The genealogical records on file in the archives of the Genealogical Society reflect this diversity. These records are also unique for another reason. A convert may do extensive genealogical research on his relatives. Records of kindreds and family lines are on file even though only one or a few of its members are affiliated with the church. Therefore, many of the marriages recorded in the records, and certainly all of those previous to 1830, are between non-Mormons.

The records can be used to estimate the frequency of first cousin marriages among

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TABLE 3. SURVEY OF DATA FOR NINE RURAL COMMUNITIES IN UTAH AND NEVADA

Community	Total Mar- riages	First Cousin	First Cousin Once Removed	Second Cousin	Second Cousin Once Removed	Third Cousin	Other Consanguinity	Total Consanguinity	α
Bunkerville, Nevada	37	0	0	4 (10.81%)	0	0	3 (8.11%)	7 (18.92%)	0.00433
Cannonville, Utah	31	0	0	0	0	0	0	0 (0.00%)	0.00000
Clarkston, Utah	162	0	3 (1.85%)	11 (6.79%)	3 (1.85%)	3 (1.85%)	1 (0.62%)	21 (12.96%)	0.00205
Fayette, Utah	45	0	3 (6.67%)	2 (4.44%)	0	1 (2.22%)	0	6 (13.33%)	0.00286
Mona, Utah	104	2 (1.92%)	2 (1.92%)	0	6 (5.77%)	2 (1.92%)	1 (0.96%)	13 (12.50%)	0.00237
Oak City, Utah	53	0	0	5 (9.43%)	1 (1.89%)	0	0	6 (11.32%)	0.00162
Oakley, Utah	59	0	0	0	1 (1.69%)	0	0	1 (1.69%)	0.00013
Porterville, Utah	65	0	1 (1.54%)	0	1 (1.54%)	1 (1.54%)	1 (1.54%)	4 (6.15%)	0.00084
Wallsburg, Utah	69	2 (2.90%)	0	1 (1.45%)	1 (1.45%)	0	0	4 (5.80%)	0.00215
Total	625	4 (0.64%)	9 (1.44%)	23 (3.68%)	13 (2.08%)	7 (1.12%)	6 (0.96%)	62 (9.92%)	0.00189

the Mormon people and their relatives during various periods of time in different regions in the United States. Ten different geographic regions were arbitrarily chosen. These are shown in table 4. The family group records were used as a source material since they are more voluminous and give a more adequate coverage of the various periods of time than the pedigree records. Since estimates of the frequencies of first cousin marriages had already been obtained for Utah in the first study, marriages occurring in this state were omitted. The early histories of southeastern Idaho, northern Arizona, and southeastern Nevada are similar because of the colonization activities of the Mormon pioneers. The frequency of consanguineous marriages for these states, as determined from the genealogical records, would be expected to reflect the Mormon populations in these states and thus be similar to Utah; hence it was thought it would be more informative to concentrate on marriages occurring in states farther removed sociologically from Utah.

The family group records were sampled; for each marriage occurring after 1620 the year and place of occurrence, and the presence or absence of a similar surname among the parents of the marriage partners were noted. When similar surnames were found, the marriage was classified as a potential first cousin marriage and records were searched to establish if a relationship existed between the marriage partners. It became apparent immediately that the potential first cousin marriages encountered in this study were much more difficult to verify than those in the first study, where only Utah marriages were investigated. These marriages fell into two groups. The first group consisted of those potential first cousin marriages that could be classified as first cousin or non-first cousin; while the second group consisted of those potential first cousin marriages that could not be identified because substantiating records were not available. A large series of family group records that would have been very helpful in classifying the potential first cousin marriages was being microfilmed when this study was in progress and was not available.

The data were grouped into classes denoted by time periods and geographical regions; in each class the potential first cousin marriages were scored as first cousin, not first cousin, or undetermined. In arriving at the final estimate of the frequency of first cousin marriages in each class, it was assumed that the frequency of first cousin marriages among the potential first cousins for which the family records were complete, was the same as among those for which the records were incomplete. For example, for the period 1720 to 1739 in the North Atlantic States, out of 4,539 marriages, 137 were classified as potential first cousin marriages. After a thorough search of all the available records had been made, 49 were reclassified as first cousins, 75 as not first cousins, and 13 as undetermined because the family records were inadequate. Consequently, $49/124 \times 13$, rounded off to the nearest whole number, was added to the number of observed first cousin marriages, resulting in a total number of 54, or 1.19 per cent, first cousin marriages for that particular class. The estimated frequency of first cousin marriages was determined in the same manner for each class.

As shown in table 4, a total of 132,524 marriages were classified. The trends over the years within each geographical region are indicated in the table. It should be stressed, however, that the marriages do not represent a random sample of those occurring in the geographical regions during the various periods of time. The mar-

Period	North Atlantic		Eastern		South Atlantic		Great Lakes		East Central		Gulf		North Central		Central		Western		Pacific Coast		Totals
	Total Marriages	First Cousins	Total Marriages	First Cousins	Total Marriages	First Cousins	Total Marriages	First Cousins	Total Marriages	First Cousins	Total Marriages	First Cousins	Total Marriages	First Cousins	Total Marriages	First Cousins	Total Marriages	First Cousins	Total Marriages	First Cousins	
1620-1639	526	0	13	0	9	0	—	—	—	—	—	—	—	—	—	—	—	—	—	0	
1640-1659	1,649	0	70	0	27	0	—	—	—	—	—	—	—	—	—	—	—	—	—	1,746	
1660-1679	2,230	7	177	0	36	0	—	—	—	—	—	—	—	—	—	—	—	—	—	2,443	
1680-1699	2,741	18	382	3	67	0	—	—	1	0	—	—	—	—	—	—	—	—	—	3,191	
1700-1719	3,261	24	538	3	100	1	1	0	2	0	—	—	—	—	—	—	—	—	—	3,902	
1720-1739	4,539	54	814	10	181	1	3	0	6	0	2	0	—	—	—	—	—	—	—	5,545	
1740-1759	5,360	63	1,172	12	297	3	12	0	17	0	2	0	2	0	—	—	—	—	—	6,862	
1760-1779	6,481	73	1,703	14	584	2	23	0	91	0	3	0	2	0	4	0	—	—	—	8,891	
1780-1799	7,827	75	2,488	17	1,168	6	79	0	355	0	21	0	6	0	8	0	—	—	—	11,952	
1800-1819	8,337	58	3,389	28	1,386	3	533	1	1,014	5	89	0	25	0	29	0	1	0	0	14,804	
1820-1839	7,946	51	4,043	36	1,487	13	1,460	7	1,407	5	223	0	74	0	118	0	10	0	6	16,774	
1840-1859	5,896	33	3,243	13	1,209	11	2,240	15	986	6	343	2	355	3	317	3	26	0	64	14,679	
1860-1879	2,567	8	1,994	4	673	9	1,981	9	621	7	451	3	410	0	452	3	64	0	152	9,365	
1880-1899	973	5	1,251	5	634	9	1,753	6	536	3	671	4	616	2	649	4	361	3	278	7,722	
1900-1919	272	0	916	2	768	1	1,960	1	593	4	1,091	5	870	0	856	0	1,148	4	956	9,430	
1920-1939	119	0	608	0	858	3	1,816	4	428	3	1,454	2	791	0	749	0	1,917	7	3,527	12,267	
1940-Present	31	0	105	0	173	0	297	0	77	1	313	0	134	0	157	0	336	1	780	2,403	
Totals	60,755	469	22,906	147	9,657	68	12,158	43	6,134	34	4,663	16	3,285	5	3,339	10	3,863	15	5,764	8	132,524
		(0.77%)		(0.64%)		(0.70%)		(0.35%)		(0.55%)		(0.34%)		(0.15%)		(0.30%)		(0.39%)		(0.61%)	

riages are a sample of those occurring among the Mormon people and their relatives in the United States. Throughout the history of the Mormon Church, proselyting has been more successful among Protestants than among individuals of other religious faiths. Missionary work has not been carried out among individuals with negro ancestry, and there is an indication that, on the average, converts have tended to come more from rural than urban areas.

DISCUSSION

Spuhler and Kluckhohn (1953) have pointed out that any discussion of inbreeding should distinguish between the two senses in which the term is often used; the social and the biologic. In the social sense, inbreeding refers to endogamic marriages, i.e., the restriction of marriages to persons within the limits of a socially defined category such as a tribe, class, or religious group. In the biologic sense, inbreeding refers to consanguineous marriages. From its beginning, the Mormon society has favored endogamous marriages, yet the results of the present investigation demonstrate that the Mormon people in Utah, when compared with other populations in the world, are not inbred in the biologic sense. In the following discussion inbreeding refers to biologic inbreeding.

The highest rate of inbreeding in Utah, taking into consideration both rural and urban populations collectively, occurred in the period 1870-1889 (Table 1). Since that time the rate of inbreeding has decreased steadily. However, the highest rate of inbreeding encountered in Utah is much less than the present rate occurring in Japan in urban centers, and the present rate in Utah is among the lowest encountered in any of the investigations carried out in the different countries in the world. The results of some of these investigations are summarized in table 5. The computed mean coefficients of inbreeding shown in table 5 are not strictly comparable because not all investigations sought information on the same degrees of relationship. However they are partly indicative of the differences existing in the rate of inbreeding among the various populations studied.

The high rate of inbreeding in Utah during the period 1870-1889, as compared with later periods, is understandable. Soon after the arrival of the Mormon pioneers in the Salt Lake Valley in 1847, communities were established in many locations in the intermountain region. Many of these communities were colonized by groups of families, such as two or three sibs, their spouses, and children. Transportation among communities was difficult and the selection of a spouse was often limited to a single community. The frequency of first cousin marriages increased in the communities as soon as the children and grandchildren of the original settlers had reached marriageable age. Another important factor which tended to increase the rate of inbreeding during this time was the commonly practiced custom of polygamy, which in many cases increased greatly the number of related persons residing in the communities. On the basis of the geographic isolation of the various communities and the practice of polygamy, the rate of inbreeding in the state never went as high as might have been expected. By the turn of the century, the rate was dropping rapidly. This is attributable to improved transportation facilities and the continual flow of converts into the settlements. It is estimated by the Historian's Office of the Mormon Church

in Salt Lake City, Utah, that between 1847 and the coming of the Union Pacific Railroad in the spring of 1869, 80,000 members of the church from the United States and Europe crossed the plains and mountains from the midwest to the Salt Lake Valley with ox or mule driven wagons or by walking and pushing handcars. From 1850 to 1900, over 30,000 converts emigrated to Utah from the Scandinavian countries (Mulder, 1955), and from 1850 to 1929, over 52,000 emigrated from Great Britain (Evans, 1937). Converts also arrived in smaller numbers from Germany, Holland, Italy, Austria, France, Switzerland, and elsewhere. In 1880, twenty-five different nationalities were represented (Mulder, 1956). The migration of non-Mormons, largely attracted by the potential of the mining industries in beginning, also tended to decrease the frequency of consanguineous marriages. At the present time it is estimated by the Membership Office of the Mormon Church that about 25 per cent of the total population in the state is non-Mormon.

One important result of the present investigation is the confirmation of the observation of Glass, in his study carried out in Baltimore, Maryland, and of Steinberg, in his study in Rochester, Minnesota, that the frequency of first cousin marriages in large segments of the population in the United States during recent time is surprisingly low when compared with the results of studies carried out elsewhere in the world. The estimate of these marriages in Utah for the period 1930-1950, based on 15,485 marriages, is 0.04 per cent, while for the ten geographic regions, omitting Arizona, Idaho, Nevada, and Utah, for the period 1940-1950, based on 2403 marriages, is 0.08 per cent. The total number of marriages for recent times can be increased by including in the sample the marriages occurring in Arizona, Idaho, and Nevada. When this is done, the sample of the marriages occurring among the Mormons and their relatives in the United States for the period 1930-1950, can be increased to 30,061. The estimate of the frequency of first cousin marriages based on this total is 0.06 per cent. This is shown in table 6. The estimate is comparable to the 0.05 per cent values obtained by Glass, and by Steinberg. Since the 0.06 per cent value is based on marriages occurring in both rural and urban populations, it is logical to conclude that the value for urban areas is much smaller, and the value for rural areas much larger. The latter conclusion has been demonstrated by the study of the nine rural communities in Utah and Nevada for which a value of 0.64 per cent was obtained (table 3).

It is of interest that the rate of inbreeding at the present time in the nine rural communities in Utah and Nevada taken as a group, is similar to that observed for recent times by Herndon and Kerley in their study of the rural population residing in Watauga County, North Carolina. Some of the results of their preliminary study for the periods 1910-1929, and 1930-1950, are shown, with their permission, in table 7. The histories of the two populations are different, yet at the present time the mean coefficients of inbreeding are similar. The frequency of three and four per cent of first cousin marriages for certain periods in the past century (table 5) could undoubtedly be demonstrated for selected small communities in Utah in previous years. For example, one of the communities shown in table 3 has a frequency value of 2.9 per cent at the present time.

Within recent years the frequency of first cousin and uncle-niece marriages has dropped considerably, but this is not true of the frequency of marriages between more

TABLE 5. ESTIMATES OF THE FREQUENCY OF FIRST COUSIN MARRIAGES AND MEAN COEFFICIENTS OF INBREEDING FOR VARIOUS POPULATIONS

Country and Number of Marriages	Author	Period	Area	Frequency of First Cousin Marriages	α
Austria:					
40,697	Orel, 1932	1901-1902	Vienna (Urban)	0.77%	0.0006
44,911	Orel, 1932	1913-1914	Vienna (Urban)	0.68%	
31,823	Orel, 1932	1929-1930	Vienna (Urban)	0.53%	
Brazil:					
3,121	Freire-Maia, 1952	1930-1950	Sao Paulo (Urban)	0.58%	0.0004
2,360	Freire-Maia, 1952	1928-1946	Sao Paulo (Sub-urban)	1.78%	0.0012
England:					
49,315	Bell, 1940	\pm 1880-1925	Parents of adult patients in general hospitals in England	0.61%	—
19,236	Bell, 1940	\pm 1925-1939	Parents of children in general hospitals in England	0.40%	—
France:					
1,410,889	Dahlberg, 1938	1876-1880	Whole country	1.03%	—
1,350,683	Dahlberg, 1938	1914-1919	Whole country	0.97%	—
—	Sutter and Tabah, 1948	1926-1947	Whole country	—	0.0007
Germany:					
5,283	Wulz, 1925	1848-1872	Bavarian Parish (Rural)	0.49%	0.0005
5,706	Wulz, 1925	1873-1897	Bavarian Parish (Rural)	0.65%	
5,193	Wulz, 1925	1898-1922	Bavarian Parish (Rural)	0.67%	
43,167	Verschuer, 1954	1899-1951	Oldenburg, part of diocese of Munster	—	0.0002
India:					
512	Sanghvi, 1954	1950	Bombay (Caste of Parsees)	12.9%	0.0092
137	Sanghvi, 1954	1950	Bombay (Caste of Marathas)	11.7%	0.0074
Ireland:					
350	Kilpatrick, <i>et al</i> , 1955	1954	County Fermanagh	0.28%	—
717	Kilpatrick, <i>et al</i> , 1955	1954	County Londonderry	1.39%	—
3,000	Kilpatrick, <i>et al</i> , 1955	1954	County Tyrone	0.20%	—

TABLE 5—*Continued*

Country and Number of Marriages	Author	Period	Area	Frequency of First Cousin Marriages	α
Japan:					
10,547	Neel, <i>et al</i> , 1949	1948-1949	Hiroshima (Urban)	3.71%	0.0029
5,510	Neel, <i>et al</i> , 1949	1948-1949	Kure (Urban)	4.10%	0.0033
16,681	Schull, 1953	1948-1949	Nagasaki (Urban)	5.03%	0.0039
Sweden:					
843	Böök, 1956	1890-1946	Parish of Pajola (Rural)	0.95%	0.0008
281	Böök, 1956	1890-1946	Parish of Junosuando (Rural)	2.85%	0.0024
191	Böök, 1956	1890-1946	Parish of Muonionalusta (Rural)	6.80%	0.0058
United States:					
8,000	Glass, 1950	±1935-1950	Baltimore, Md.	0.05%	—
1,969	Steinberg, 1950	±1935-1950	Rochester, Minn.	0.05%	—
98	Herndon & Kerley, 1952	1830-1849	Watauga County, N. C. (Rural)	4.08%	0.0030
143	Herndon & Kerley, 1952	1850-1869	Watauga County, N. C. (Rural)	2.80%	0.0035
299	Herndon & Kerley, 1952	1870-1889	Watauga County, N. C. (Rural)	3.01%	0.0055
446	Herndon & Kerley, 1952	1890-1909	Watauga County, N. C. (Rural)	1.13%	0.0021
439	Herndon & Kerley, 1952	1910-1929	Watauga County, N. C. (Rural)	0.91%	0.0018
226	Herndon & Kerley, 1952	1930-1950	Watauga County, N. C. (Rural)	0.00%	0.0006

distant relations (table 1). The extremely low frequency of first cousin marriages in recent times in Utah is probably largely attributable to the state law in existence since 1907 prohibiting these marriages, as well as to the social stigma associated with them in certain segments of society. Twenty-nine other states have a similar law against the marriage of first cousins (Mackay, 1951). The Mormon Church has no doctrinal restrictions against the marriage of closely related persons.

The law in many of the states against the marriage of first cousins often induces these individuals to travel to states other than their own to be married. For example, in the study of the ten geographical regions, two first cousin marriages occurred during the period 1940-1950. The individuals involved in one of the marriages were both Mormons from a rural area in Utah. The marriage was performed in New Mexico, which permits the marriage of first cousins. Four of the six first cousin marriages occurring in the Pacific Coast region from 1920 to 1939 involved Mormon rural residents of Utah and Idaho who were married in California, where the marriage is legal. This shows that estimates of the frequency of these marriages in a specific geo-

TABLE 6. FREQUENCY OF FIRST COUSIN MARRIAGES AMONG THE MORMONS AND THEIR RELATIVES IN THE UNITED STATES FROM 1930 TO 1950

Place	Total Number of Marriages	Number of First Cousin Marriages	Percentage of First Cousin Marriages
Within Utah	15,485	6	0.04
Outside Utah	14,576	12	0.08
Total	30,061	18	0.06

TABLE 7. PRELIMINARY RESULTS OF COUSIN MARRIAGE RATES FOR WATAUGA COUNTY, NORTH CAROLINA FOR THE YEARS 1910 TO 1950 (HERNDON AND KERLEY, 1952)

Period	First Cousin	First Cousin Once Removed	Second Cousin	Second Cousin Once Removed	Third Cousin	Third Cousin Once Removed	Fourth Cousin	Total	Number of Marriages	α
1910-1929	4 (0.91%)	4 (0.91%)	15 (3.42%)	14 (3.19%)	14 (3.19%)	0	0	51 (11.62%)	439	.00176
1930-1950	0	1 (0.44%)	2 (0.88%)	4 (1.77%)	9 (3.98%)	3 (1.33%)	4 (1.77%)	23 (10.18%)	226	.00061
Total	4 (0.60%)	5 (0.75%)	17 (1.80%)	18 (2.71%)	23 (3.46%)	3 (0.45%)	4 (0.60%)	74 (11.13%)	665	.00127

graphic region, shown in table 4, especially in recent times due to the ease of transportation, may not reflect the frequency among the persons actually residing there.

In the survey of the family group records, no attempt was made to distinguish whether the marriage partners were Mormons or non-Mormons. The Mormon people are now scattered throughout the United States, but the majority still reside in Utah and nearby states. With the exception of the western states during the times of the early history of the Mormon church when polygamy and geographical isolation played an influential role, it is doubtful if any significant differences have ever existed between Mormons and non-Mormons living under similar circumstances in the different parts of the United States in regard to the frequency of first cousin marriages. This is suggested by the similarity of the results of the present investigation with those of Glass, Steinberg, and Herndon and Kerley. It should also be considered in this respect that all the marriages recorded in the family group records occurring before 1830, and an undetermined number occurring since 1830, concern the non-Mormon relatives of converts. Although it has been mentioned that the converts to Mormonism have tended to come from Protestant families residing in rural areas, those estimates in table 4 that are based on ample data may be useful as estimates for the white populations living in the various geographic regions during the different periods of time, and not just for the Mormons and their relatives.

The only other estimates of the frequency of first cousin marriages in a white population in the United States that are available for comparative purposes, besides those of Glass, Steinberg, and Herndon and Kerley, are those determined by Arner (1908) for the state of New York, previous to 1784, and for Ashtabula County, Ohio,

for the years 1811 to 1866. The estimate for the New York population, based on 10,198 marriages, was 2.76 per cent, while the estimate for the Ashtabula County population, based on 13,309 marriages was 1.12 per cent. These estimates are much greater than those found in the present study during similar periods of time for the geographic regions including those areas. There is evidence that Arner's estimates are too high. Arner counted marriage licenses and determined the number of marriages between persons with similar surnames. From a study of printed genealogical records he then estimated that about one-third of all marriages between persons with similar surnames were first cousins, and that marriages between first cousins with similar surnames constitute about one-fourth of the total number of first cousin marriages. These values were used in estimating the frequency of first cousin marriages in the two populations.

In addition to the possible errors in the one-third and one-fourth values, which Arner recognized and discussed, another possible source of error which he apparently overlooked, was the assumption that the surname of the female appearing on the marriage license is always her maiden name. This assumption is not always true due to the high frequency with which divorced couples remarry each other. For the second marriage the female's married name appears on the marriage license. The error involved would not be as large for the populations studied by Arner as it is at present due to the increased divorce rate in recent times (Bureau of the Census, 1955). The influence of this source of error can be demonstrated from the analysis of 12,268 marriage licenses filed in Salt Lake County, Utah, for the years 1949 to 1953. Similar surnames appeared in 198 of these marriage licenses. Following the method of Arner, the estimate of the frequency of first cousin marriages would be 2.15 per cent, which is clearly much too large. Since 1919, persons applying for a marriage license in Salt Lake County have been required to record the names and places of birth of their parents. By checking these application forms and noting the bride's maiden name, the number of marriages between persons where the male's surname was similar to the female's maiden name was reduced from 198 to 26. The difference between these two figures is due to the reconciliation of divorced couples. Clearly, marriage licenses by themselves are inadequate for a study of this type. One-third of 26, or about 9 marriages are estimated to be between first cousins, and $4 \times 9 = 36$ is the estimated total number of first cousin marriages, using the values Arner derived from genealogy records. This gives an estimate of 0.30 per cent for the frequency of first cousin marriages. This is still not in agreement with the value obtained from the analysis of the family group records.

Pedigree and family group records on file in the archives, plus other records, showed that 19 of the 26 marriages between individuals with similar surnames were not between first cousins. Correspondence with the individuals involved in five of the other marriages resulted in the necessary genealogical information to demonstrate that they also were not first cousins. Conclusive evidence could not be obtained for 2 of the 26 marriages, but the available information indicated that neither was a first cousin marriage. It is evident that the frequency of first cousin marriages between persons with similar surnames among the total number of marriages between persons with similar surnames is much lower in Salt Lake County for the years 1949 to 1953, than

the one-third value used by Arner in his studies of New York and Ashtabula County, Ohio. If it is assumed that 1 of the 26 was a first cousin marriage, it would be estimated, using Arner's method, that 4 of the 12,268 marriages, or 0.03 per cent were between first cousins. Morton (1955) has summarized the data collected in Europe and Japan which indicates that for these populations, the frequency of marriages between first cousins is closer to 5 times, rather than 4 times, the frequency of marriages between first cousins with similar surnames. Using the value of 5 as the correction factor increases the estimate of the frequency of first cousin marriages to 0.04 per cent.

The analysis of the marriage licenses for Salt Lake County for the years 1949 to 1953 leads to two conclusions. The first is that Arner's estimates of the frequency of first cousin marriage licenses for New York and Ashtabula County, Ohio, may be too high, and second, that the frequency of these marriages for recent times in Salt Lake County, which is the most densely populated county in the state, is extremely low, much lower than the 0.04 per cent value estimated for the whole state during the period 1930-1950.

Although the data are not numerous for the classes in question, it appears from table 4 that the greatest frequency of first cousin marriages occurred in the South Atlantic states during the years following the Civil war. This supports the observation of Herndon and Kerley, who found that the highest rate of inbreeding occurred in Watauga County, North Carolina, during this time. An increase in these marriages also occurred in the East Central states, and to a slight degree in the Gulf states, during the years following the war.

Considering all the regions as a group, the data indicate that the greatest frequency of first cousin marriages in the United States occurred during the period 1720-1759. This reflects the frequency value for the population living in the North Atlantic states. Since that time the frequency has dropped steadily. In general, on the basis of these data, the trend for the whole country has been the same as that for the North Atlantic states.

The data show a large variation in the frequency of first cousin marriages from class to class in some of the geographic regions. For example, during the period 1800-1819, a relatively low frequency of these marriages was observed for the South Atlantic States. The frequency is much lower than that observed for the preceding and following periods. It is not known if this is due to sampling error, the movement of people preceding or following the War of 1812, or some other factor. The unexplained variation in some cases could be due to the shortcomings of the family group records. Extensive genealogical research by a convert or converts from a specific segment of the population would result in a large number of family group records concerning that segment of the population. Consequently a sample of records for marriages occurring in a given geographic region during a specific period of time could be biased in this respect.

It is unfortunate that more is not known about the rate of inbreeding of the various segments of the population in the United States. Stern (see discussion of paper by Buzzatti-Traverso, 1950) has suggested that one important source of data would be the records of the Catholic Church. Cousin marriages are permitted among the mem-

bers only by special dispensation. A survey of their records for the different states should give the desired information.

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SUMMARY

The frequency of consanguineous marriages has been determined for the Mormon people and their relatives living in Utah and in ten geographic regions in the United States with the aid of genealogical records on file in the archives of the Genealogical Society of the Church of Jesus Christ of Latter Day Saints (Mormon), in Salt Lake City, Utah. In addition, nine rural communities in Utah and Nevada were surveyed for the frequency of consanguineous marriages among the present residents. It is demonstrated that the frequency of first cousin marriages in large segments of the population in the United States is surprisingly low (about .05 per cent) in recent years when compared with the frequencies for populations in other parts of the world, and that rural populations have a higher rate of inbreeding than urban populations. The frequencies of all types of consanguineous marriages in Utah are reported for different periods of time from 1847 to 1950, and for first cousin marriages in the United States for different periods of time from 1620 to 1950.

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